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SOLUTION OF A PROBLEM.

BY GEORGE H. HARVILL, BONNER, LOUISIANA.

Problem.—What must be the size of an auger that will cut away just half of a solid ball 3 inches in diameter, by boring two holes, perpendicular to each other, through its center?

Solution.—Let r = radius of ball and x = radius of the auger. The volume of the ball is $\frac{4}{3}\pi r^3$. The part bored away will consist of the volumes of two cylinders, $ABDE$ and $GKIH$ minus the volume cut from one of the cylinders by the other plus the four segments at the ends of the two cylinders, which must = $\frac{1}{2}$ of $\frac{4}{3}\pi r^3$ = $\frac{2}{3}\pi r^3$. The volume of each cylinder = $2\pi x^2 \times \sqrt{(r^2 - x^2)}$, . . . that of the two cylinders = $4\pi x^2 \sqrt{(r^2 - x^2)}$. The volume cut from one cylinder by the other is $\frac{2}{3}$ the cube of the diameter of its base = $\frac{2}{3}(2x)^3$ = $\frac{16}{3}x^3$. The volume of each segment = $\frac{2}{3}\pi r^2[r - \sqrt{(r^2 - x^2)}] - \frac{1}{3}\pi x^2 \sqrt{(r^2 - x^2)}$, hence that of the four segments = $\frac{8}{3}\pi r^2[r - \sqrt{(r^2 - x^2)}] - \frac{4}{3}\pi x^2 \sqrt{(r^2 - x^2)}$. Hence, putting $r=1$ for convenience, we have the eq'n

$$4\pi x^2 \sqrt{(1-x^2)} + \frac{8}{3}\pi - \frac{8}{3}\pi [\sqrt{(1-x^2)}] - \frac{4}{3}\pi x^2 \sqrt{(1-x^2)} - \frac{16}{3}x^3 = \frac{2}{3}\pi;$$

whence by reduction we find

$$8x^3 + 4\pi \sqrt{(1-x^2)} = 3\pi.$$

Solving this equation by trial, I find $x = .474595$, or $x = .474595r$.

For a sphere 3 inches in diameter, $x = .711892$ inches.

If the holes are cut with a chisel, instead of an auger, what must be the width of the chisel?

SOLUTIONS OF PROBLEMS IN NUMBER ONE.

SOLUTIONS of problems in No. 1, have been received as follows:

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